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Dechlorination of monochlorobenzene using organic mediators

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Abstract

In the presence of an organic mediator such as dibenzofuran, the reduction of chlorobenzene occurs indirectly and at substantially less negative potentials compared to its direct reduction at a glassy carbon cathode in acetonitrile. By using the indirect, mediator approach to reduction of chlorobenzene, constant current electrolysis at carbon plate cathodes can give complete dechlorination with high current efficiency. Both divided and undivided cells were used, each having their own advantages. Besides dibenzofuran, naphthalene and biphenyl were successfully tested as organic mediators for chlorobenzene reduction. During the entire electrolysis, the mediator concentration remained practically constant so that substantially less mediator was required in comparison to the substrate, i.e., chlorobenzene. Higher concentrations of mediator can be beneficial, e.g., a dibenzofuran: chlorobenzene ratio of 2.5:5 as compared to 1:5, if the electrolysis is to be conducted at higher current density. For electrolysis of large amounts of chlorobenzene, an approach where the substrate is added periodically to a solution of the (reduced) mediator is recommended. A comparison of the results from direct vs. indirect dechlorination of chlorobenzene clearly demonstrates the substantial superiority of the latter approach.